



United States Department of Agriculture

# Wood Products Used in Residential Repair and Remodeling in the United States, 2014

Joe Elling  
David B. McKeever



Forest  
Service

Forest Products  
Laboratory

General Technical Report  
FPL–GTR–256

April  
2018

## Abstract

The repair, remodeling, and renovation of existing residential structures and properties has been, and continues to be, a vital market for the use of wood products in the United States. This market is either the first or second largest market (alternating with new residential construction) for a number of wood products including softwood lumber, engineered wood products, and wood-based sheathing. In 2014, an estimated 13.5 billion board feet of softwood lumber, 4.2 billion board feet of hardwood lumber, 0.1 billion board feet of engineered lumber, 3.8 billion ft<sup>2</sup> (3/8-in. basis) of structural panels, and 2.1 billion ft<sup>2</sup> (3/8-in. basis) of nonstructural panels were used for all repair and remodeling activities. More than 90% of all these wood products were used for repair or remodeling of owner-occupied houses, with the remainder being used for renter-occupied dwellings. As shown by similar studies conducted in 2003 and 2006, usage of all wood products in 2014 was down by about 5% compared with 2003 and 20% compared with 2006.

**Keywords:** residential repair and remodeling, consumption, expenditures, wood use, lumber, structural panels, nonstructural panels, end use markets

*This report is a revised version of a previously published APA report. The text has been revised, but the data are the same.*

April 2018

Elling, Joe; McKeever, David B. 2018. Wood products used in residential repair and remodeling in the United States, 2014. General Technical Report FPL-GTR-256. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 31 p.

A limited number of free copies of this publication are available to the public from the Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53726-2398. This publication is also available online at [www.fpl.fs.fed.us](http://www.fpl.fs.fed.us). Laboratory publications are sent to hundreds of libraries in the United States and elsewhere.

The Forest Products Laboratory is maintained in cooperation with the University of Wisconsin.

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the United States Department of Agriculture (USDA) of any product or service.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [http://www.ascr.usda.gov/complaint\\_filing\\_cust.html](http://www.ascr.usda.gov/complaint_filing_cust.html) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: [program.intake@usda.gov](mailto:program.intake@usda.gov).

USDA is an equal opportunity provider, employer, and lender.

English unit	Conversion factor	SI unit
inch (in.)	25.4	millimeter (mm)
square foot (ft <sup>2</sup> )	0.092903	square meter (m <sup>2</sup> )
board foot	0.00236	cubic meter (m <sup>3</sup> )
billion = 10 <sup>9</sup>		

## Acknowledgments

This project was sponsored by APA—The Engineered Wood Association, FPInnovations, and the USDA Forest Service, Forest Products Laboratory. Data services were provided by Home Innovation Research Labs, 400 Prince George's Boulevard, Upper Marlboro, MD, 20774, and FPInnovations, 2665 East Mall, Vancouver, British Columbia, Canada, V6T 1Z4.

## Contents

Executive Summary .....	1
Introduction .....	1
Components of U.S. Housing Stock, by Structure Type and Tenure .....	2
Characteristics of Projects Undertaken .....	4
Historical Trends in Repair and Remodeling Projects, Owner-Occupied Housing .....	6
Means for Estimating Wood Product Use in Residential Repair and Remodeling in the United States .....	18
Summary of Wood Usage in Residential Repair and Remodeling in the United States .....	18
Wood Products Used in Cabinets and Countertops .....	23
Wood Products Used in Siding .....	24
Wood Products Used in Outdoor Structures .....	27
Implications for Future Residential Repair and Remodeling Activity .....	28
Literature Cited .....	29
Appendix A—Housing Unit Definitions .....	31

# Wood Products Used in Residential Repair and Remodeling in the United States, 2014

**Joe Elling**, Director of Market Research  
APA—The Engineered Wood Association, Tacoma, Washington

**David B. McKeever**, Research Forester, Retired  
USDA Forest Service, Forest Products Laboratory, Madison, Wisconsin

## Executive Summary

Preserving the existing housing stock in the United States through maintenance and repairs and upgrading the quality of existing structures through room additions or remodels have been vital components of the demand for a variety of wood products. A wide array of factors influence decisions made by existing homeowners or owners of rental properties concerning what types of repair and remodel projects to undertake, when to do them, and how to finance the projects. The last time APA—The Engineered Wood Association and the USDA Forest Service, Forest Products Laboratory cosponsored a detailed analysis of the use of wood products in residential repair and remodeling in the United States was for the year 2006, which was at the height of the housing bubble. Coincidental with the bursting of the housing bubble, repair and remodeling activity fell sharply in the United States but not to the same degree as new residential construction. Until now, the high cost of tracking the details around the use of wood products in repair and remodeling prohibited updates of the 2006 study. This study is for the year 2014. It is slightly smaller in scale than the 2006 study but should still provide valuable insights concerning the trends related to the types of projects undertaken, expenses incurred, and wood products used across project types. The current study is organized in the following manner. Following the introduction, there is a general overview of the U.S. housing stock relating to the number of units, structure type, and ownership structure. One of the legacy effects from the bursting of the housing bubble is that with the drop in homeownership rate, there was a decline in the number of owner households and a relatively large shift of single-family detached units into the rental stock. This is followed by a detailed review of the trends in projects undertaken by homeowners, based on the Census Bureau's bi-annual American Housing Survey. For the most part, the number of projects undertaken and spending per project in 2014 were below the levels determined for 2006. This should not be a surprise, given the extremes on the upside for the drivers of repair and remodeling in 2006, sluggish economic growth since the end of the recession in 2009, and the changed perceptions regarding return on investment in housing. The third major section of this study is a comparison of estimated wood

products use in repair and remodeling for 2014 with the prior study years of 2003 and 2006. These estimates are based on the Home Innovation Research Labs survey of consumer practices concerning use of wood products in repair and remodeling. Where appropriate, concerns regarding the estimates are raised. For example, in several instances, it appears that the use of plywood is being overstated relative to that of oriented strandboard. The study concludes with a statement reinforcing how unusual the boom in repair and remodeling was in the prior decade and that for the coming 3 to 5 years, growth may run slightly faster than that of incomes (in the range of 3% per year).

## Introduction

Repair and remodeling of residential structures and properties has been a vital market for the use of wood products in the United States. In fact, repair and remodeling applications are either the first or second largest market for a number of wood products, next to new residential construction (McKeever and Howard 2011). The last time a detailed study of wood product usage for residential repair and remodeling was undertaken was for the year 2006, with results being published in February 2009 (Adair and McKeever 2009). Similar to new residential construction, the repair and remodeling market experienced a dramatic decline in activity from the 2005 peak through 2010 as implied by the data for sales from dealers of building materials and garden equipment and supplies (Fig. 1). Since hitting bottom in 2009 and virtually flattening through 2013, sales at these stores had risen 12% by 2015 but were still 16% below the 2005 peak.

Retail sales data can provide us a general impression of the cycle in repair and remodeling activity but are insufficient to help us understand how the mix of projects undertaken may have changed through the cycle and where the activity stood in 2015. For the purposes of this study, data from the American Housing Survey (AHS), conducted by the U.S. Department of Commerce Bureau of the Census, will be used to depict the mix of projects undertaken, in what types of structures, the age of the structures, who did the work, and how the projects were financed. If possible, more detailed data will be provided concerning projects that have been deemed to be the most wood-product intensive.





**Figure 1. Sales at building materials and garden equipment supplier dealers (USDC 2018c).**

Examples of these types of projects include rooms added to the structure, remodels of kitchens and bathrooms, and outdoor additions, such as decks, porches, and garages.

Estimates of wood product usage in repair and remodeling projects are based on the Consumer Practices Survey (CPS) conducted by researchers at the Home Innovation Research Labs (HIRL) (Upper Marlboro, Maryland) for the year 2014. Approximately 50,000 households were surveyed, with the split being roughly 80% residents of owner-occupied housing units and 20% residents of renter-occupied units. In 2014, there were 118.2 million occupied housing units in the United States. Therefore, the results are based on a sample of 0.04% of the occupied housing units. This is a much smaller sample share compared with the Annual Builders Practices Survey conducted by HIRL, in which roughly 3% of the new units built are captured. Researchers at HIRL provide survey participants with detailed product descriptions and pictures to aid in the process of filling out the form. However, based on product estimates, it is not clear that products were always correctly identified. Throughout this report, statements will be made if HIRL estimates appear inconsistent with other indicators and available data.

## Components of U.S. Housing Stock, by Structure Type and Tenure

Before delving into the details of the project data from AHS and product use estimates from HIRL, it is important to provide an overview of the dynamics of the U.S. housing stock in total and then by tenure choice (owner-occupied or renter-occupied). These data can be used to project incidence rates of projects undertaken, which should be of value in terms of forecasting growth in the repair and remodeling sector. The AHS is completed every two years in odd-numbered years. The most recent survey year was 2015 (USDC 2017).

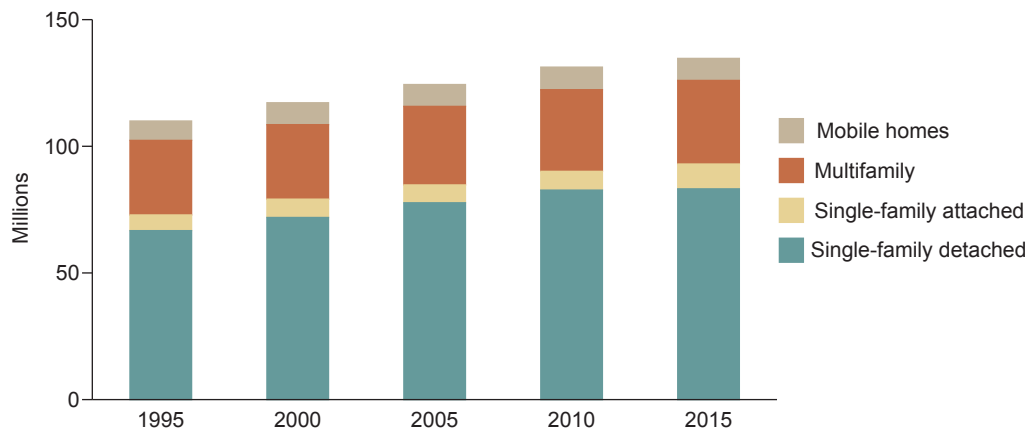
For the survey year 2015, the Census Bureau estimated that the total number of units in the housing stock was 134.8 million and they were segmented in the following manner:

- 83.2 million single-family detached
- 9.8 million single-family attached
- 33.0 million multifamily units
- 8.7 million mobile homes

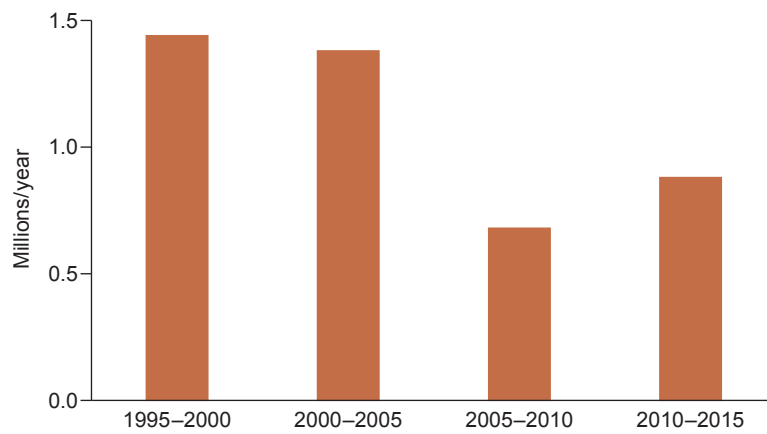
See Appendix for housing unit definitions. The data in Figure 2 depict the trend in the composition of housing stock since 1995. During the 20-year period, the U.S. housing stock expanded by 22%, or a little more than 1% per year, on average. Single-family detached units accounted for 61% of all housing units in 1995, and by 2015, they accounted for 63% of all housing units. The mobile home stock has been essentially flat at 8.7 million units, implying that demand for new mobile homes is driven by replacement of homes because disaster or a state of disrepair has rendered them uninhabitable.

With respect to occupancy in 2015, about 88% of all units were occupied on a full-time basis. Roughly 4.5% of units were seasonal or used occasionally. Another 5.5% of units were vacant, because they were either for sale, for rent, or in transition from one occupant to another. The remaining 2% of units in the stock were not occupied and were held off the market because they were in the foreclosure process or for other reasons.

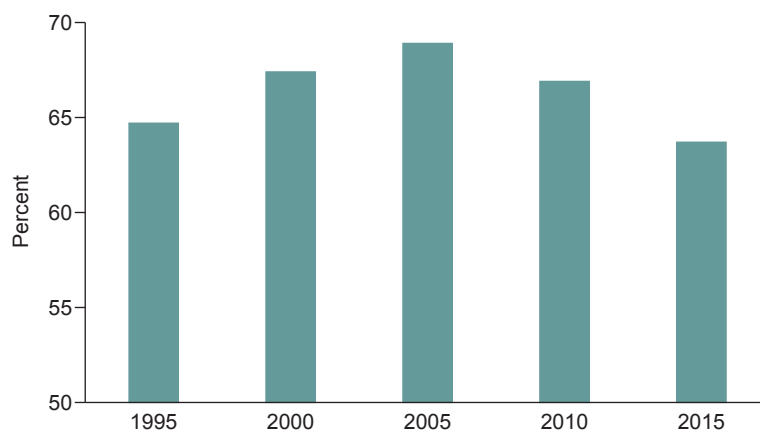
Growth in the stock of owner- and renter-occupied units is driven by the growth in households and the tendency to own versus rent. Household growth in total averaged roughly 1.4 million per year from 1995 to 2005 then slowed to far less than 1 million per year in the following 10 years because of the Great Recession of 2007 through 2009 and slow economic growth from 2010 to 2015 (Fig. 3). As shown in Figure 4, homeownership rate fell from its peak of nearly 69% in 2005 to 63.7% in 2015, which was below the level of 64.7% registered in 1995.



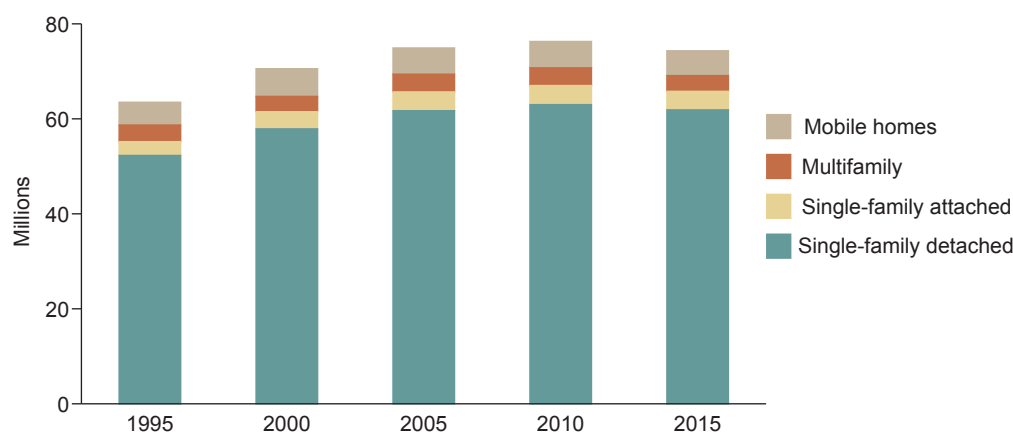
**Figure 2. Stock of all housing units in the United States by structure type for selected years (USDC 2017).**



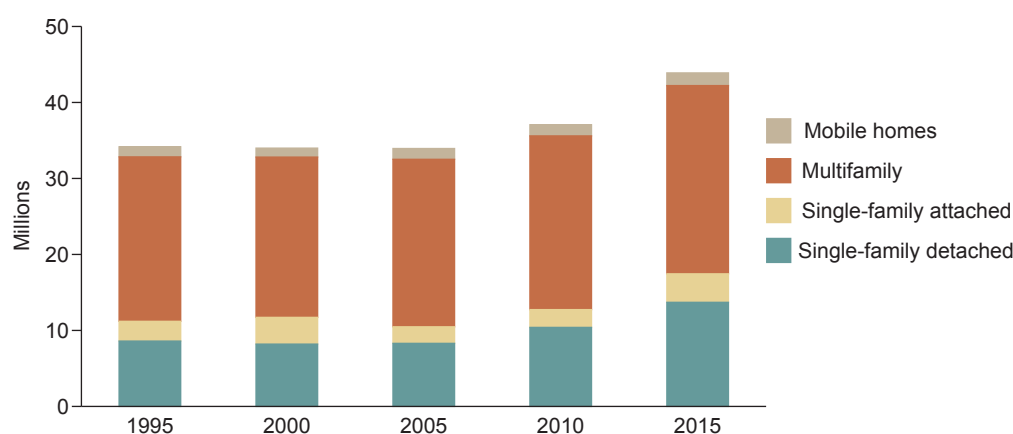
**Figure 3. Average annual growth in households, 1995–2015, for selected years (USDC 2018a).**



**Figure 4. Homeownership rate in selected years (USDC 2018b).**



**Figure 5. Number of owner-occupied units in the United States by structure type for selected years (USDC 2017).**



**Figure 6. Number of renter-occupied units in the United States by structure type for selected years (USDC 2017).**

The combined effect of slower household growth and decline in homeownership rate from 2005 to 2015 led to virtually no growth in the number of owner-occupied households during that 10-year period (Fig. 5). Single-family detached homes throughout the 20-year period running from 1995 to 2015 consistently accounted for 82% to 83% of the owner-occupied units. Mobile homes accounted for 7% to 8% of the owner-occupied stock. Single-family attached and multifamily units have each accounted for about 5% of the owner-occupied units since 1995.

Consistent with the steady decline in homeownership rate, the number of renter households marched upwards during the last 10 years (Fig. 6). One thing to note in Figure 6 is the relatively large increase in the number of single-family units, both detached and attached, that became part of the rental stock. From 1995 to 2005, single-family units accounted for 30% to 35% of the occupied rented units. However, in 2015, roughly 40% of the rental units were estimated to be single-family units. This was driven by the foreclosure of units, which were then transformed into rental properties by investors.

The absorption of the foreclosed single-family units by renter households meant that the houses were not vacant for very long and hence sustained the demand for new single-family units, albeit at levels that were well below half of what existed at the peak of the housing bubble. The shift in some units to rental housing caused the owner-occupied share of single-family detached homes to fall from an average of 88% from 1995 to 2005 to 83% in 2015. With respect to occupied multifamily housing unit structures, there was a slight increase in the rental share from 1995 to 2010, followed by an average of 86% to 88% in 2015. Typically, the demand for new single-family homes is associated with growth in owner-occupied units and the demand for new multifamily units is associated with growth in renter households.

## Characteristics of Projects Undertaken

When the 2006 repair and remodeling study was completed, the Census Bureau published estimates of repair and remodeling expenditures by owner- and renter-occupied

units. From there, the data were segmented according to expenditures geared to maintenance and repairs, additions, and alterations. Unfortunately, the Census Bureau discontinued publishing these data in 2008. However, the Census Bureau has maintained its estimates of repair and remodeling projects undertaken in owner-occupied housing as part of the bi-annual AHS. Researchers at Harvard's Joint Center for Housing Studies in 2015 provided detailed analyses of the project data through 2013. For this report, we combined that set with the most recent data from the 2015 survey to present a historical perspective of the trends in repair and remodeling.

The list of projects tracked is extensive and segmented in the following manner:

- Repairs necessitated by disasters: earthquake, tornado, hurricane, lightning, fire, flood, and other
- Room additions: bedroom, bathroom, kitchen, recreation room, and other (A room can be added through an addition to the structure, finishing an unfinished room, or structural changes within the house.)
- Room remodels: bathroom and kitchen
- Exterior additions and replacements: attached garage or carport; porch, deck, patio, or terrace; roofing; siding; windows or doors; chimneys; stairs; or other
- Interior additions and replacements: insulation, water pipes, plumbing fixtures, electrical wiring, fuse boxes, breaker switches, security systems, flooring, carpeting, paneling, ceiling tiles, HVAC systems, water heaters, dishwashers, garbage disposals, and other
- Lot or yard additions and replacements: driveways, walkways, fencing, walls, swimming pools, tennis courts, recreational structures, sheds, detached garages, other buildings, landscaping, sprinkler systems, and other

For the purposes of this study, the focus will be on those projects that are wood-products intensive and include the following:

- Room additions
- Room remodels
- Exterior additions and replacements, excluding chimneys, stairs, and other
- Sheds, detached garages, and other buildings

The 2015 AHS data show that the listed wood-products intensive projects accounted for an estimated 25% of all projects identified and 50% of the expenditures.

Before discussing the historical trends in the projects undertaken, it is of value to look at the tendency of the projects to be done by a professional relative to being done by the homeowner. As shown in Table 1, professionals accounted for more than 50% of the projects undertaken,

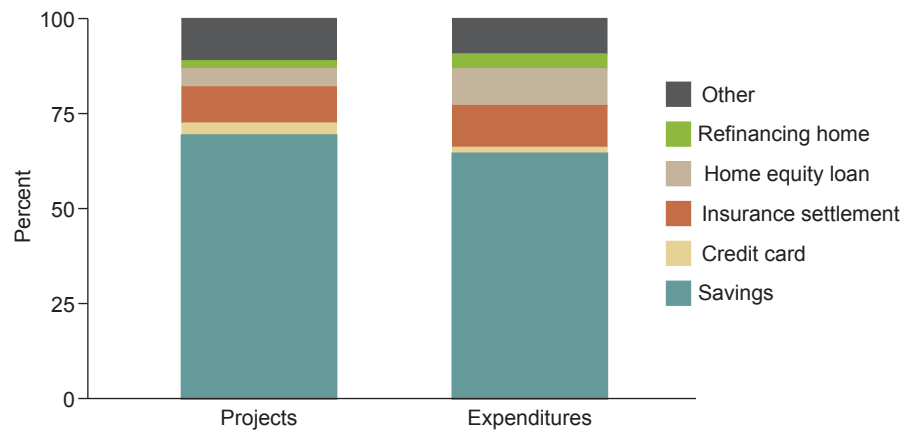
**Table 1—Percentage of projects performed by a professional, 2010–2015**

Project	Percentage done by a professional
Bathroom or kitchen remodel	53
Room addition or renovation	51
Rec room and other	50
Bedroom	45
Bathroom	55
Kitchen	71
Roofing	82
Siding	69
Deck–porch addition	55
Garage–carport addition	56

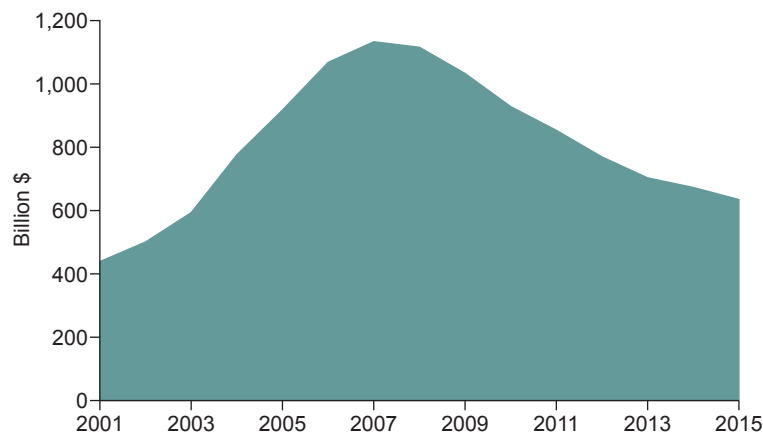
regardless of the job, with the exception of a bedroom addition (to existing unfinished space) or renovation. Roof replacements and repairs had the highest share done by a professional at 82%, most likely because of the difficulty and level of danger involved.

One critical variable to consider in advance of looking at the historical trends in repair and remodeling projects is the means of financing. Researchers at the Census Bureau did not include a set of questions concerning this until the 2015 survey. The results from the survey, which cover the years 2013 through 2015, are summarized in Figure 7. Roughly 73% of the wood-products intensive projects were reported to be financed with cash from savings, whereas cash from savings accounted for 69% of the total repair and remodeling expenditures. Insurance settlements driven by disaster repairs accounted for 6.5% of the projects and 7.3% of the payments.

Home equity loans were said to have been used to finance nearly 4.5% of the wood-products intensive projects and accounted for 9% of the expenditures. According to the survey, the use of a home equity loan tended to be more prevalent when undertaking an addition to the structure, such as a room or a garage. The use of home equity loans to finance certain projects will be referred to later in this report when looking at the specific project trends. The easy access to home equity loans during the height of the housing bubble helped to support not only a surge in the number of projects undertaken but also more expensive projects. Since the bursting of the housing bubble, the amount of home equity loan debt outstanding has fallen by roughly \$500 billion ( $\times 10^9$ ), or 44%, since the end of 2007 (Fig. 8). Some of the decline in home equity loan debt has been driven by write-offs or rollovers into first mortgages that carry a lower interest rate. Regardless of the reason, the data in the chart reinforce the conviction that the drop in home equity driven by the collapse in home prices has played a role in constraining repair and remodeling activity.



**Figure 7. Relative distribution of means of financing repair and remodel projects in owner-occupied housing, wood-intensive projects, 2013–2015 (USDC 2017).**



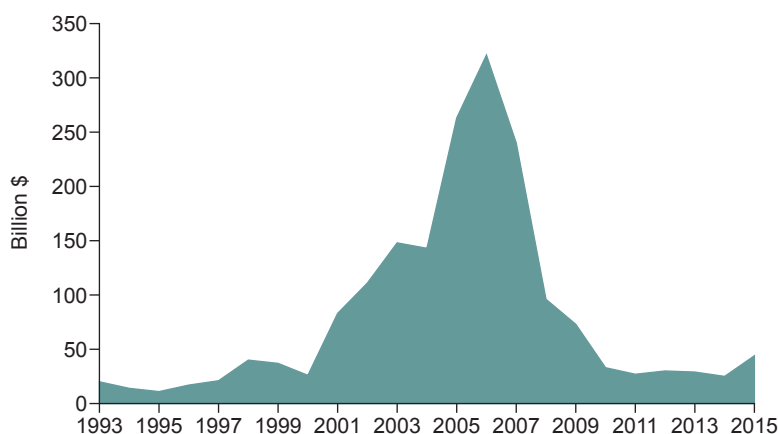
**Figure 8. Home equity loan debt outstanding, end of year, for selected years (FRB 2018b).**

The financing data also illustrate that cash-outs from refinance played a very small role in supporting repair and remodeling activity in 2013 through 2015. Based on the estimated cash-out from mortgage refinance from the research staff at Freddie Mac, this should not be a surprise (Fig. 9). According to the AHS data, cash-outs contributed roughly \$8 billion, or 4%, of the financing of the wood-products intensive projects in the years 2013, 2014, and 2015. The Freddie Mac cash-out estimates show that the \$8 billion used to finance repair and remodel projects accounted for 8% of the cash-out volume of the \$92 billion spent in those years. To illustrate the potential impact of homeowners using their homes as a cash machine at the height of the housing bubble to finance repair and remodeling projects, let's assume that 8% of the cash-outs were spent this way. Cash-outs in 2005, 2006, and 2007 totaled \$823 billion; 8% of that is \$66 billion. The collapse in cash extracted from mortgage refinance goes a long way to explain the 28% decline in wood-products intensive project expenditures that took place from 2007 to 2015.

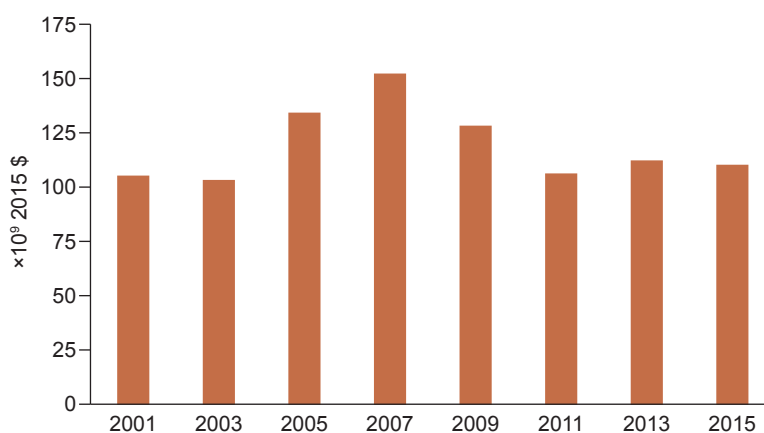
## Historical Trends in Repair and Remodeling Projects, Owner-Occupied Housing

The combined efforts by the Census Bureau in conducting the AHS and the Harvard Joint Center for Housing Studies provides the means to illustrate how the same factors that contributed to the extraordinarily high levels of single-family construction during the housing bubble also contributed to the repair and remodeling of owner-occupied houses. Repair and remodel project estimates for rental housing are not provided by the Census Bureau. The project and expenditure data for owner-occupied housing is based on a sample that covers 0.1% to 0.2% of the population of owner households. This suggests that variations in the published results from survey year to survey year are susceptible to variability in the sample. Given that single-family detached homes typically account for 82% to 83% of the owner-occupied stock, the project data essentially reflect repair and remodeling of single-family detached units.





**Figure 9. Cash-out volume from refinance of prime conventional mortgage loans for selected years (Freddie Mac 2018).**



**Figure 10. Repair and remodeling expenditures, wood-intensive projects, for selected years (JCHS Harvard University 2017).**

If we accumulate the expenditures across all project types and adjust for inflation, the pattern in Figure 10 for the survey years dating back to 2001 fits with the key drivers. From 2001 to 2007, the following factors gave rise to a 50% increase in expenditures:

- Growth in the number of owner households
- Increased turnover in the existing stock of homes as the number of existing single-family homes sold rose by 34% from 2000 to 2005
- The \$5 trillion gain in home equity caused by rising home prices gave existing homeowners the economic wherewithal to invest in their homes, and they were aided by the push of mortgage lenders to help support the use of their home as a cash machine to help finance the surge in spending
- The conviction that home prices only go up; therefore, spending on fixing up the existing structure was the best investment possible

Of course, all the factors that gave rise to the surge from 2001 to 2007 reversed course when the Great Recession occurred. As a result, average expenditures for the survey

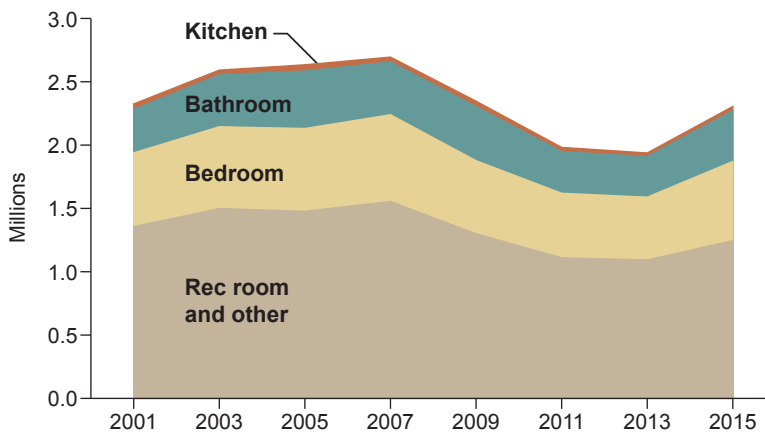
years of 2011, 2013, and 2015 were up less than 5% from the average of 2001 and 2003.

In the following discussion, data pertaining to projects undertaken by type, incidence rate, and average expenditures will be reviewed. Projects that are more discretionary, such as adding a room to the structure, experienced the biggest cyclical swings, both in terms of number and average expenditures. In contrast, projects that were more likely to be maintenance driven experienced smaller swings.

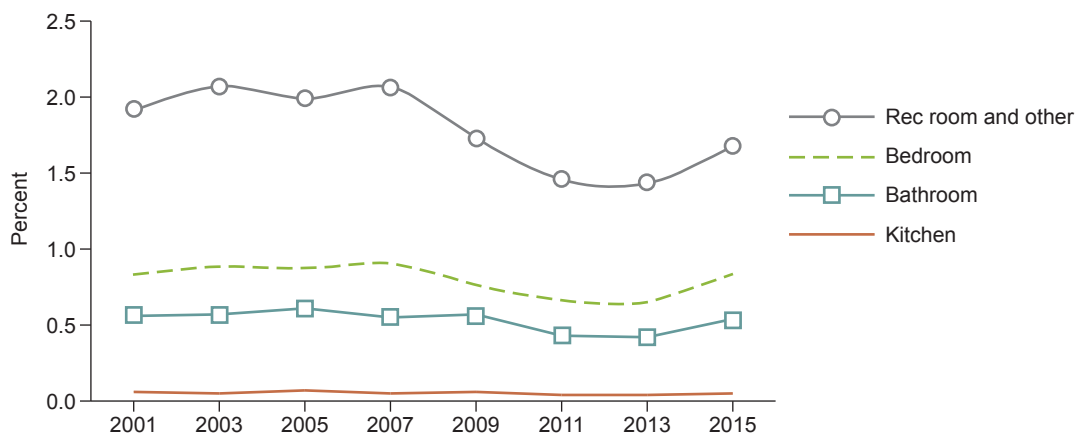
### Room Additions

The AHS accounts for room additions in three ways:

- Create a room from unfinished interior space, which is quite common for rec rooms
- Add a room on to the existing structure, which will involve products used for flooring, walls, roofs, and siding
- Structural changes within the structure, such as taking a large room and inserting a dividing wall to make two rooms



**Figure 11. Number of room additions by type for selected years (JCHS Harvard University 2017).**



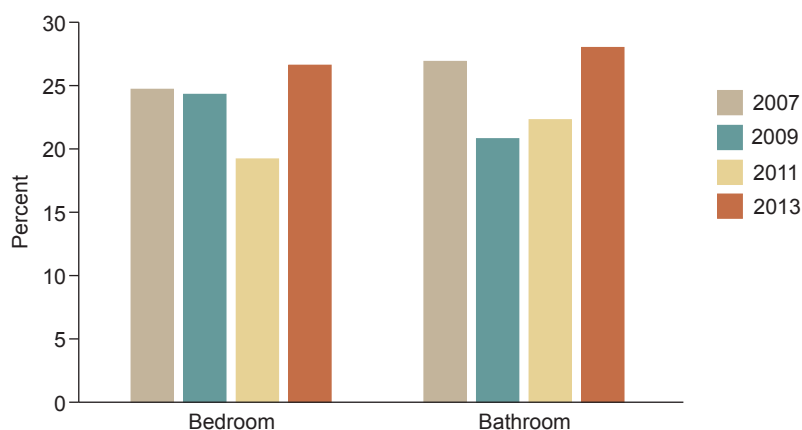
**Figure 12. Incidence rate of room additions by type for selected years (JCHS Harvard University 2017).**

Figure 11 shows the number of room addition projects from 2001 to 2015. The addition of a rec room or another room that is not a bedroom, bathroom, or kitchen has consistently accounted for 56% of all room additions in this time span. Bedroom additions accounted for another 25% of the additions. Bathrooms accounted for 17%, and the remaining 2% were kitchens.

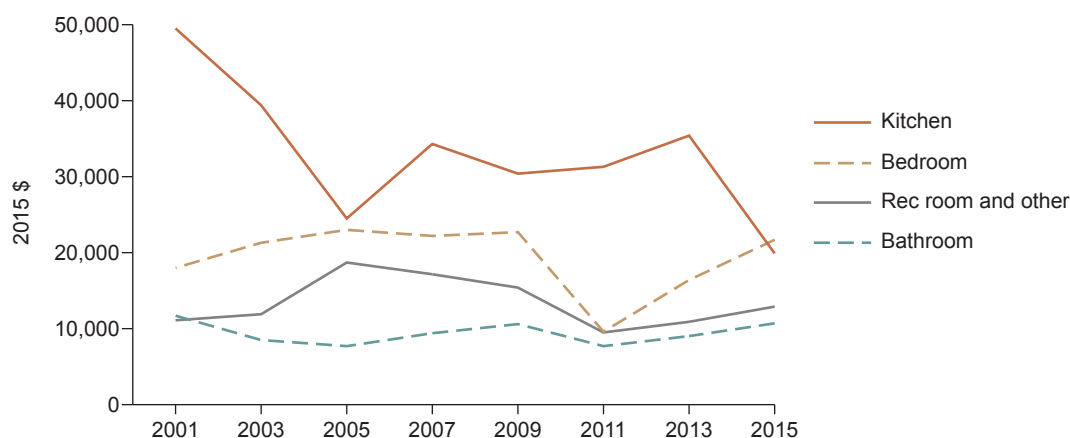
The number of room additions increased 13% from 2001 to 2007, which was partially driven by a 7% increase in the number of owner households. The remaining 6% increase was driven by a rise in the incidence rate, which is the percentage of households that engaged in a room addition project in the survey year. As shown in Figure 12, the incidence rate of room additions was higher in 2007 than in 2001. With the larger number of owner-occupied homes, it does not take a big increase in the incidence rate to result in a meaningful increase in the number of room additions. Under the weight of the Great Recession and the sluggish recovery, the incidence rate for room additions fell until 2013. This decline in the incidence rate essentially

accounted for room additions in 2013 being down 29% from the 2007 peak. That rec rooms and other rooms experienced the biggest decline should not be a total surprise. The rationale for this assertion is that a rec room in a new home can be unfinished and then finished at a later time. Because of the collapse in new home construction, there was a smaller inventory of unfinished rec rooms available to be finished.

The Census Bureau did not start tracking the means in which a room was added until 2009, and this was not part of the reported 2015 data. This is a valuable piece of information, because it provides insight in terms of possible wood products usage. A room that is added to the structure is going to require more wood products than the finishing of a room or a change in the structure, such as dividing one room into two. The data in Figure 13 show that add-ons to the existing home accounted for a smaller share of all room additions in 2011 than in 2007. Add-ons as a share of bedroom and bathroom additions bounced back in 2013, whereas add-ons of other types of rooms fell further. Rec



**Figure 13. Percentage of room additions as add-ons to home by type for selected years (JCHS Harvard University 2017).**



**Figure 14. Average expenditures per room addition by type for selected years (JCHS Harvard University 2017).**

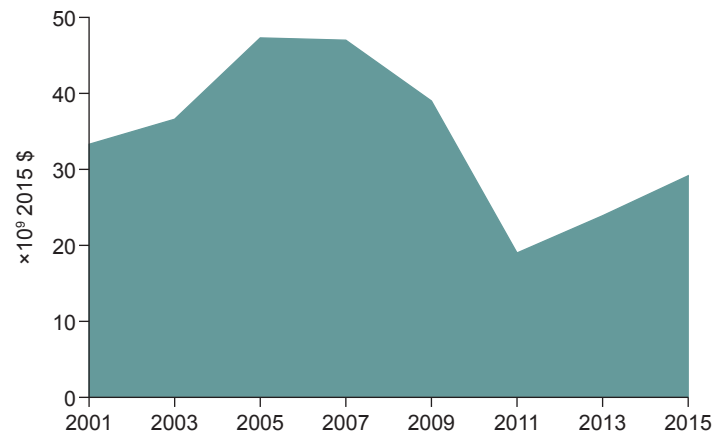
rooms were excluded from this survey because they are typically already located in the basement of the original structure and just require finishing in most cases.

The final piece of data to help us understand the cycle in repair and remodel expenditures is average expenditures per project, which can be influenced by the means in which a room is added as previously shown. Given the ease of obtaining financing and the mentality that prevailed during the housing bubble, the expectation was that more elaborate additions took place in the middle part of the 2000 to 2010 decade than what took place in the first half of the 2010 to 2020 decade. To some degree, this expected pattern occurred because average expenditures per bedroom addition in 2011 and 2013 were below that of the previous decade but then rebounded in the 2015 survey (Fig. 14). Average expenditures per rec room and other room additions from 2011 to 2015 were consistently less than those of 2005 through 2009.

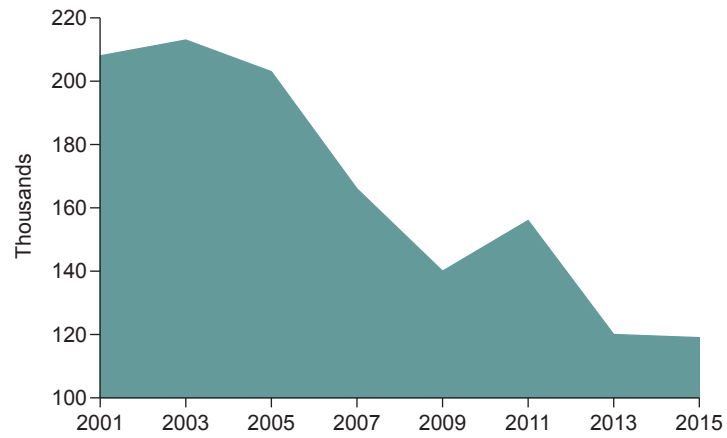
The mix of fewer room additions taking place and, to some degree, lower expenditures per addition left total expenditures for room additions in 2015 roughly 40% below the peak reached at the height of the housing bubble in 2005 and 2007 (Fig. 15). As mentioned earlier, creating a room by adding square footage to the house is probably the most discretionary of the repair and remodel projects that are undertaken. The set of factors in place is unlikely to be repeated in the next 3 to 5 years, because the ease in which such projects were financed is not available and the expectation of return on investment is not the same as 10 years ago either.

### Garage and Carport Additions

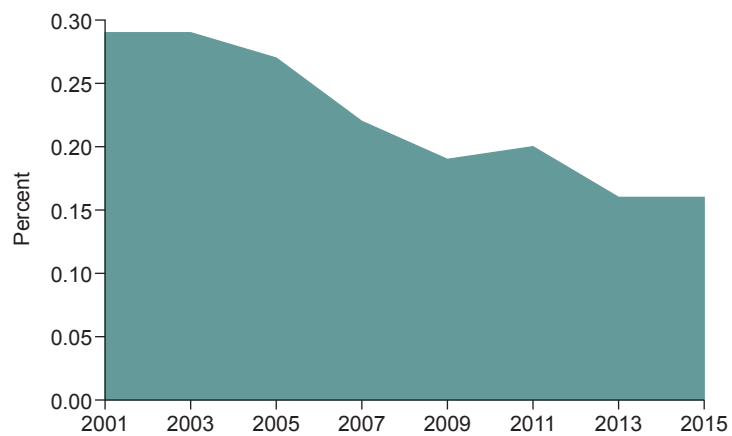
Another form of addition to the structure of a home is the construction of an attached garage or carport. The number of garage or carport additions has been on a downward trend after peaking in 2003 (Fig. 16). This trend should not be a surprise because, as the attributes of new homes



**Figure 15. Total expenditures on room additions for selected years (JCHS Harvard University 2017).**



**Figure 16. Attached garages and carports added to homes for selected years (JCHS Harvard University 2017).**

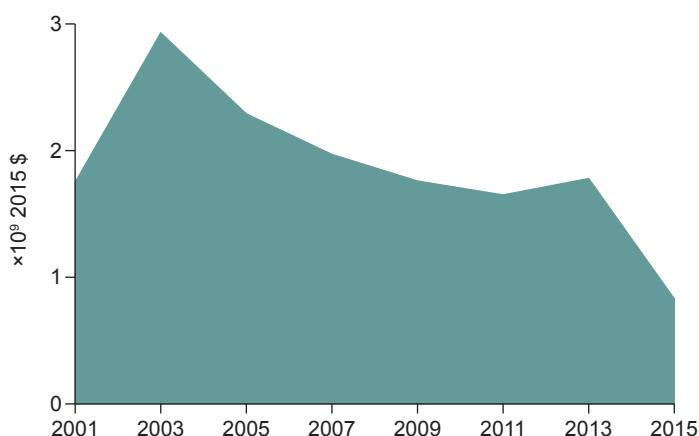


**Figure 17. Incidence rate of attached garages and carports added to homes for selected years (JCHS Harvard University 2017).**





**Figure 18. Average expenditures per garage or carport addition for selected years (JCHS Harvard University 2017).**



**Figure 19. Total expenditures on garage and carport additions for selected years (JCHS Harvard University 2017).**

have improved, the share of new single-family homes built without a garage or carport has been on the decline. In the 1970s and 1980s, more than 20% of the new single-family homes built did not have a garage or carport. In the 1990s, this number fell to 14% and has averaged 10% since 2000. In its tabulation of new single-family units built without a garage or carport, the Census Bureau does not identify if the housing unit is detached or attached. It is quite common for a townhouse or rowhouse to not come with a garage or carport; this may account for a majority of the homes built without a garage. Lending support to this assumption is that attached units have accounted for 12% of the single-family starts in this decade, which is very near the average of 11% that was experienced from 1980 to 2010.

The incidence rate for garage and carport additions has fallen from just shy of 0.3% in 2001 to 0.15% in 2015 (Fig. 17). According to the 2015 Annual Housing Survey, 16% of the owner-occupied single-family homes, or 10 million in number, did not have a garage or carport. If we calculate the incidence rate this way, the incidence rate in 2015 was 1.2%. That there are almost 10 million homes

without a garage or carport suggests there is the potential for this type of project to rebound if those homeowners decide it is worth the expense.

The Census Bureau does not separate the data by number of garages and carports; therefore, we do not know how the expenditures vary by type of parking facility. The best that we can say is that the average cost has usually run between \$10,000 and \$15,000 (Fig. 18). The 2001 and 2015 values seem low, and this could be a problem of sampling variability or error.

Since 2007, expenditures on garage and carport additions have run below \$2 billion per year and, in turn, have accounted for less than 2% of all repair and remodel expenditures (Fig. 19).

### Deck and Porch Additions and Renovations

The trend in additions and renovations of decks and porches is similar to that of garage and carport additions (Fig. 20). The rate of descent for this type of project has been less severe, about 30% since the first half of the previous decade compared with 44% for garages and carports.



**Figure 20. Additions and renovations of decks and porches for selected years (JCHS Harvard University 2017).**



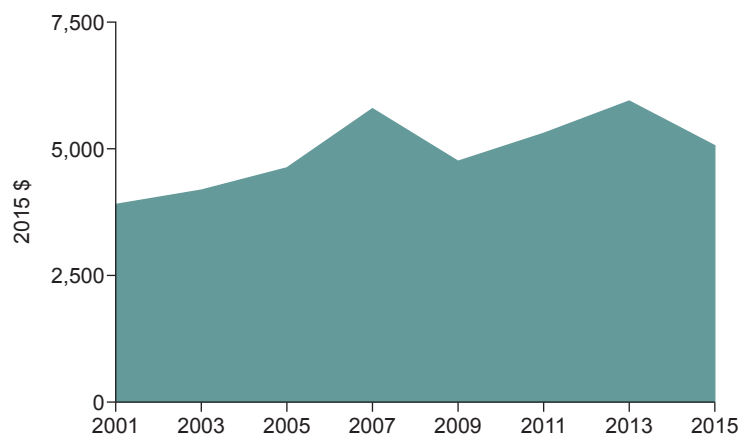
**Figure 21. Incidence rate of deck and porch additions and replacements for selected years (JCHS Harvard University 2017).**

The incidence rate has fallen from roughly 1.25% in the 2001 to 2005 time period to 0.85% in this decade (Fig. 21). The prevalence of a deck, porch, or patio on an existing single-family detached home was 91% according to the 2015 Annual Housing Survey, which is similar to the estimate coming from the 2005 survey. For the existing single-family attached units, roughly 86% were estimated to have a deck or porch. This percentage is also close to the share of new single-family homes, detached and attached combined, built with a deck or porch, which has averaged roughly 88% in this decade. The Census Bureau does not separate the data by projects that were additions and those that were renovations. Hence, it is possible that the decline after 2005 for the total is a reflection of fewer new homes built and cases in which the owner was going to do the project himself at a later date. With improved materials that are more durable, the need to renovate an existing deck may have become less necessary. Also, owners may have not had the means to finance a renovation and have chosen to undertake basic maintenance to extend the life of the existing structure as is.

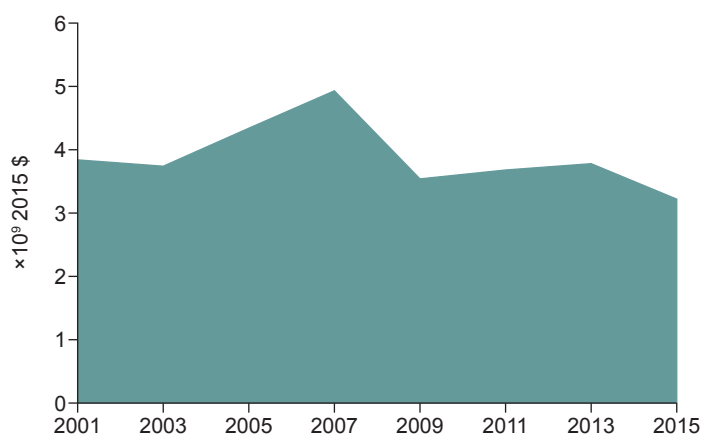
Although there has been an upward trend in average expenditures per deck or porch project, the increase has not been enough to offset the drop in the number of projects; therefore, expenditures beginning in 2009 are less than what they were in 2001 (Figs. 22 and 23).

### Bathroom and Kitchen Remodels

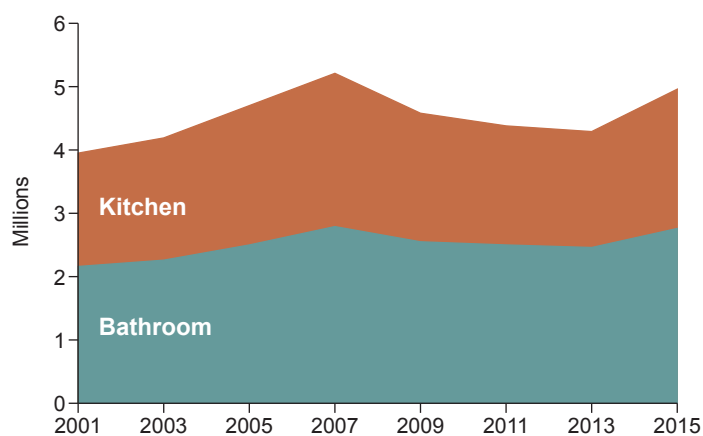
Similar to room additions, the timing of a bathroom or kitchen remodel is influenced by the homeowner's ability and willingness to finance the project. It is not surprising, then, to see that the total number of bathroom and kitchen remodel projects rose from 4 million in 2001 to 5.2 million in 2007, an increase of 32% (Fig. 24). Then with the onset of the Great Recession, the total number of remodels fell to 4.2 million in 2013, a decline of 17%. The 2015 survey shows a sharp increase in remodels back to nearly 5 million. In 2015, bathroom remodels were almost back to their 2007 peak of 2.8 million, whereas kitchen remodels were still 10% below the 2007 peak of 2.42 million.



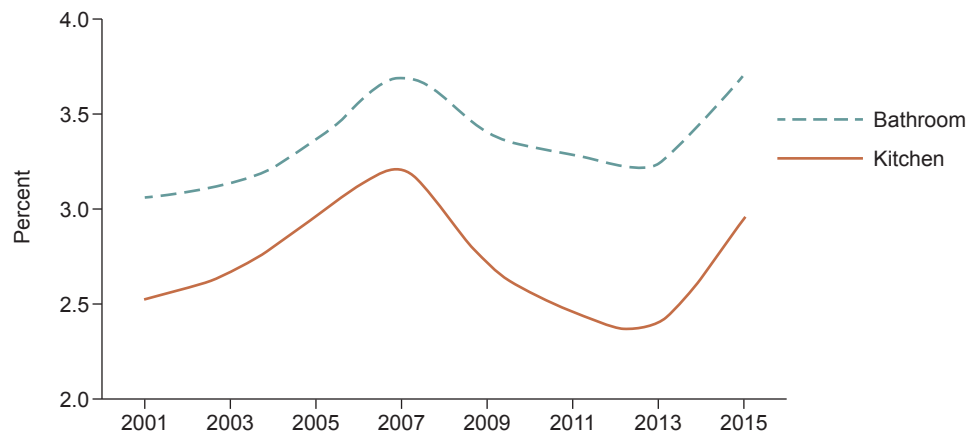
**Figure 22. Average expenditures per deck or porch project for selected years (JCHS Harvard University 2017).**



**Figure 23. Total expenditures on deck and porch additions and renovations for selected years (JCHS Harvard University 2017).**



**Figure 24. Number of bathroom and kitchen remodels for selected years (JCHS Harvard University 2017).**



**Figure 25. Incidence rate of bathroom and kitchen remodels for selected years (JCHS Harvard University 2017).**



**Figure 26. Average expenditures per remodel project for selected years (JCHS Harvard University 2017).**

The data in Figure 25 depict the incidence rates for kitchen and bathroom remodels. The cyclical patterns are not a surprise considering that kitchen remodels are more sensitive to financing and consumer willingness to undertake because they are relatively expensive.

Average expenditures per kitchen remodel certainly fit the expected pattern running from 2001 to 2015. As shown in Figure 26, average expenditures per kitchen remodel jumped from \$8,600 in the 2001 and 2003 surveys to \$12,600 in 2007 and fell back to less than \$10,000 in each of the survey years in this decade. In percentage terms, expenditures per bathroom remodel in the three survey years in this decade have been about 20% below those of the 2007 peak. In contrast, kitchen remodels during the same period averaged 24% less compared with the 2007 peak.

The mix of the increase in the number of bathroom and kitchen remodels and the rise in expenditures per remodel led to an 81% increase in the total bathroom and kitchen remodel expenditures from 2001 to 2007 (Fig. 27). The decline in the number of projects and spending per project

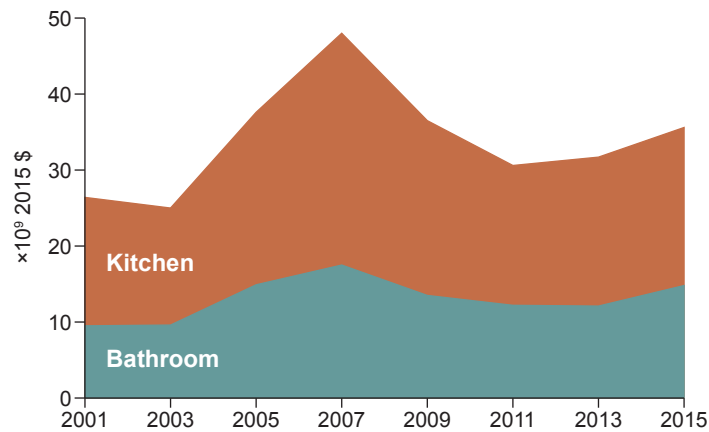
drove down remodeling expenditures by 35% in 2011 to 2013 relative to 2007. The increase in 2015 still left remodeling expenditures 26% below that of 2007. The wood products most impacted by the cycle in these remodels are those most heavily used in the manufacture of kitchen cabinets and bathroom vanities and will be discussed later in this report.

## Roofing Projects

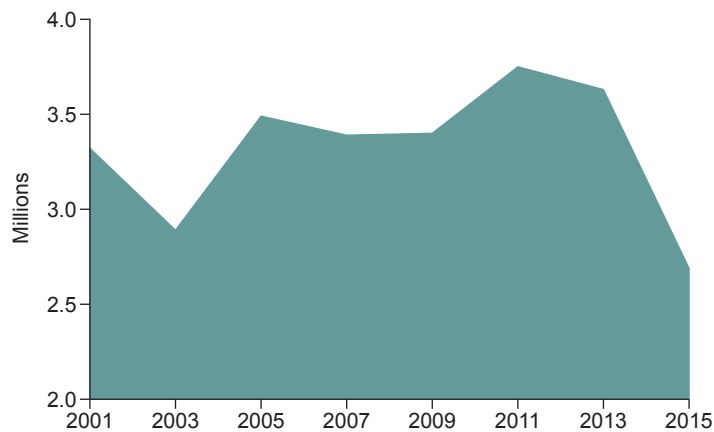
A roofing project can be driven by the addition of a room or the need to replace a portion of or the entire roof after a disaster or because of routine maintenance. Compared with other forms of projects reviewed in this study, the number of roofing projects has held relatively steady, averaging roughly 3.3 million per year in the eight surveys (Fig. 28). Intuitively, this makes sense, because the repair of a roof problem is not discretionary. A home owner cannot put off replacing an aged or damaged roof for very long.

The relative stability in the number of roofing projects implies the same for the incidence rate. Even if the

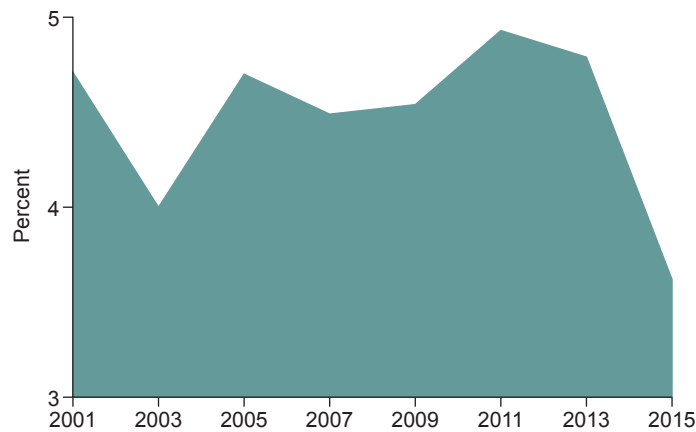




**Figure 27. Total expenditures of bathroom and kitchen remodels for selected years (JCHS Harvard University 2017).**



**Figure 28. Number of roofing projects for selected years (JCHS Harvard University 2017).**

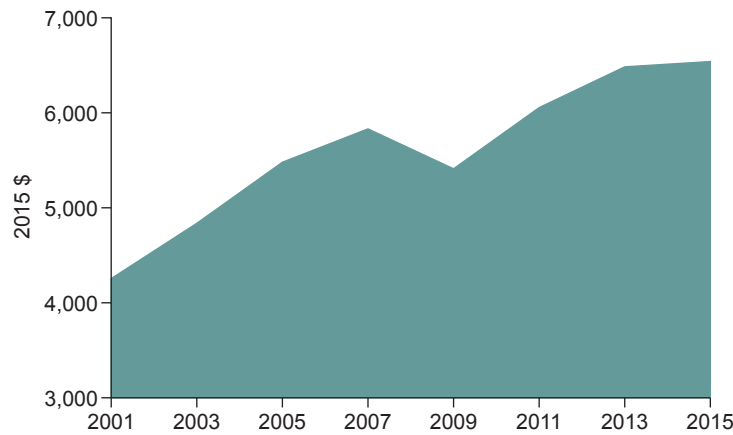


**Figure 29. Incidence rate of roofing projects for selected years (JCHS Harvard University 2017).**

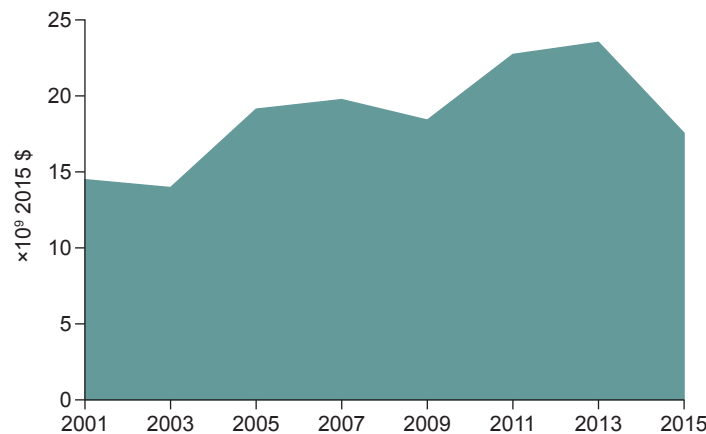
year 2015, which is probably an outlier, is included, the incidence rate of roofing projects in all owner-occupied housing structures was 4.5%. Consistent with single-family detached units accounting for 83% of the owner-occupied

housing units, single-family detached units accounted for 85% of the roofing projects in 2015 (Fig. 29).

Average expenditures on roofing projects have been on an upward trend for the last 15 years. The upward trend



**Figure 30. Average expenditures per roofing project for selected years (JCHS Harvard University 2017).**



**Figure 31. Total expenditures on roofing projects for selected years (JCHS Harvard University 2017).**

in expenditures per roofing project could partially reflect a higher rate of increase in material costs relative to the general inflation rate measure that the Harvard Joint Center for Housing Studies used for adjusting all expenditures for inflation. For example, the general inflation rate has averaged close to 2% annually from 2001 to 2015 but the annual cost increase of asphalt roofing materials and coatings averaged 5% during the same period. The price measure, however, could be overstating the cost increases because the Bureau of Labor Statistics is not adjusting for higher quality, such as longer-lived roofs that carry longer warranties. Professionals have consistently performed about 80% of the roofing projects; therefore, the upward trend in expenditure per project cannot be tied to the possibility of professionals handling a greater share of the projects (Fig. 30).

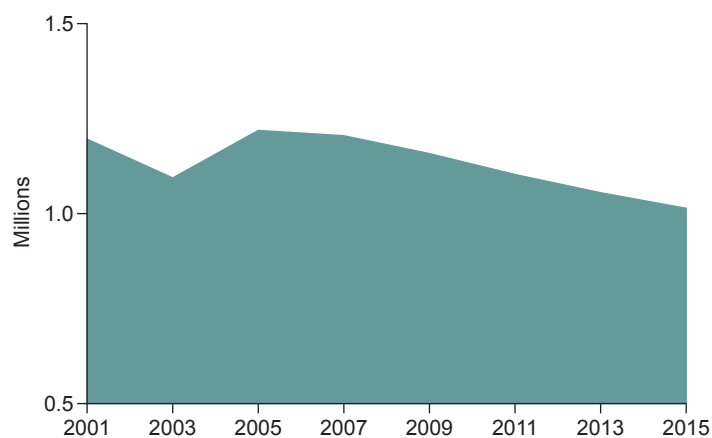
The upward trend in expenditures per project drove the roofing repair market to an average of \$23 billion in the 2011 to 2013 survey years (Fig. 31). The decline in 2015 was driven by the estimated decline in projects. For 2011

and 2013, roofing projects accounted for around 22% of all expenditures in owner-occupied housing (Fig. 31).

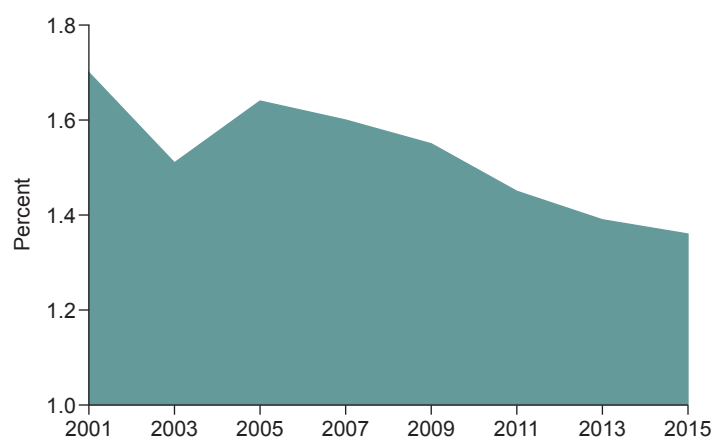
### Siding Projects

The number of siding projects undertaken has been on a gradual downward trend since 2005 (Fig. 32). This could be driven by the changes in siding materials that have occurred since the 1980s. According to Census Bureau data, wood siding products as the primary material were used on 40% of the new single-family homes in the 1980s. Since then, the trend has gone downwards, and in this decade, about 7% of the new single-family homes built had a wood product as the primary siding material. More durable vinyl, stucco and fiber cement have been substituted for wood, with the degree of substitution depending on the region of the country.

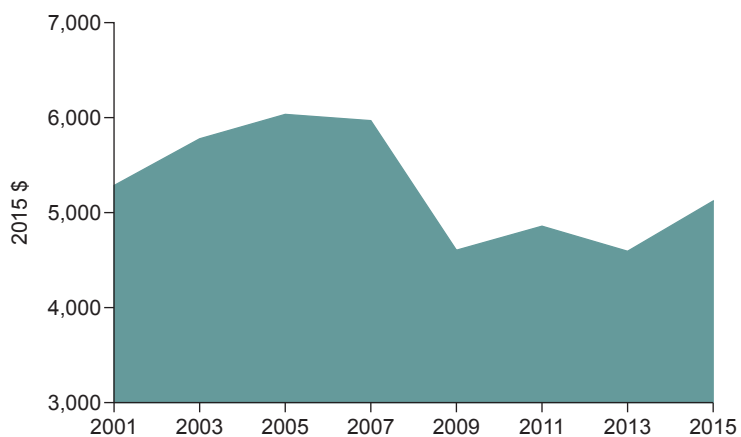
Consistent with the decline in siding projects undertaken, the incidence rate fell from 1.61% in 2005 to just under 1.4% in 2013 and 2015, a drop of 15% (Fig. 33).



**Figure 32. Number of siding projects for selected years (JCHS Harvard University 2017).**



**Figure 33. Incidence rate of siding projects for selected years (JCHS Harvard University 2017).**



**Figure 34. Average expenditures per siding project for selected years (JCHS Harvard University 2017).**



**Figure 35. Total expenditures on siding projects for selected years (JCHS Harvard University 2017).**

The average amount spent on a siding project fell from the peak of \$6,000 in 2005 and 2007 to just \$4,800 in the survey years from 2009 to 2015 (Fig. 34).

The combination of the downward trend in the number of projects undertaken and spending per project has led to nearly a 30% decline in the amount spending on siding repairs since 2005 (Fig. 35).

## Means for Estimating Wood Product Use in Residential Repair and Remodeling in the United States

Estimates of wood products usage in residential repair and remodeling in the United States are based on the results of the CPS conducted by HIRL. The household sample for this survey totals roughly 50,000, with the sample split roughly 80% owner-occupied households and 20% renter-occupied households. The survey form may be completed by the owner or renter of the occupied unit or by the contractor, if appropriate. The households surveyed by HIRL are not the same as those households surveyed by the Census Bureau as part of the AHS. The household sample size for the two surveys is similar at roughly 50,000. This has been the case since 2000. In both surveys, the sample size captures less than 0.04% of all households in the United States, implying there is an extremely low probability of any overlap in terms of survey participants in each sample. However, there is similarity in the qualitative aspects of the samples. For example, in both samples, roughly 83% of the owner-occupied respondents lived in single-family detached units.

## Summary of Wood Usage in Residential Repair and Remodeling in the United States

The preceding discussion with respect to the trends in projects undertaken and dollar spending levels suggest

that wood products usage in 2014, the most current year of interest, should have been less than that of 2006 and 2003, with 2006 being greater than 2003. The data in Table 2 tend to support this hypothesis in the framing and sheathing applications because the estimates of lumber and engineered wood products in framing and structural panels in sheathing are lower in 2014 than in previous years. In other words, the number of room additions and expenditures on room additions in 2014 were less than those of 2006 and 2003.

The estimates of the number of kitchen and bathroom remodels and their associated expenditures from the AHS used as a guide for wood products usage in millwork give the expectation that numbers for 2014 would have been less than those for 2006 and greater than those for 2003. However, the usage estimates of softwood lumber and structural panels do not coincide with these expectations. Total lumber use in 2014 is on par with that of 2006, which is greater than expected but in line with the expectations relative to 2003. Structural panel use is estimated to be considerably greater in 2014 than in 2006, with the 2006 estimate being less than that of 2003, which is also counter to expectations. Total nonstructural panel use fits with expectations, although there appears to be a shift away from the use of hardwood plywood toward composite panels.

What follows is a more detailed comparison of the estimated wood products usage between 2006 and 2014 for the various applications for both owner-occupied and renter-occupied properties and, where available, a comparison with estimated usage of nonwood products.

## Floor Applications

Wood products usage in floor applications can be tied to the addition of a room to the existing structure or to damage repair to the existing structure. The work can be done by the occupant or by a professional. As shown in Table 3, the amount of lumber and I-joists used in floor applications in 2014 totaled 413 million board feet equivalent, down 65% from the 2006 amount of 1.172 billion board feet equivalent.



**Table 2—Amount of wood products used in the U.S. repair and remodeling market for selected years**

Wood product	Amount of product		
	2003	2006	2014
<b>Framing (<math>\times 10^6</math> board feet)</b>			
Lumber and beams, softwood	12,677	14,350	10,467
Engineered wood	153	283	108
Total	12,830	14,633	10,575
<b>Sheathing (<math>\times 10^6</math> ft<sup>2</sup>, 3/8 in.)</b>			
Plywood, softwood	3,323	3,899	1,558
Oriented strandboard	1,266	1,668	918
Total, structural panel sheathing	4,589	5,567	2,476
Nonstructural panel sheathing	70	105	72
Total sheathing	4,659	5,672	2,548
<b>Millwork</b>			
Lumber ( $\times 10^6$ board feet):			
Softwood	2,760	2,882	3,081
Hardwood	2,754	4,374	4,157
Total	5,514	7,256	7,238
Panels ( $\times 10^6$ ft <sup>2</sup> , 3/8 in.):			
Plywood, softwood	858	709	1,227
Oriented strandboard	44	85	57
Total structural panels	902	794	1,284
Plywood, hardwood	238	545	163
Other nonstructural panels	1,173	1,764	1,857
Total nonstructural panels	1,411	2,309	2,020
Total panels	2,313	3,103	3,304
<b>Summary of all uses</b>			
Lumber and engineered wood ( $\times 10^6$ board feet):			
Lumber, softwood	15,437	17,232	13,548
Lumber, hardwood	2,754	4,374	4,157
Engineered wood	153	283	108
Total lumber and engineered wood	18,344	21,889	17,813
Panels ( $\times 10^6$ ft <sup>2</sup> , 3/8 in.):			
Plywood, softwood	4,182	4,608	2,785
Oriented strandboard	1,310	1,753	975
Total structural panels	5,492	6,361	3,760
Plywood, hardwood	238	545	163
Other nonstructural panels	1,243	1,869	1,929
Total nonstructural panels	1,481	2,414	2,092
Total panels	6,973	8,775	5,852

**Table 3—Wood usage in floor framing by type of housing for two selected years**

Product	Wood usage ( $\times 10^6$ board feet or BFE <sup>a</sup> )					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Lumber	852	276	46	39	898	315
I-joist (BFE)	260	79	14	19	274	98
Total	1,112	355	60	58	1,172	413

<sup>a</sup>BFE, board feet equivalent.**Table 4—Wood usage in floor sheathing, coverage of first and upper floor area, by housing type for selected years**

Product	Wood usage ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	833	240	61	21	894	261
OSB	280	123	5	7	285	130
Other <sup>a</sup>	63	26	0	5	63	31
Total	1,176	389	66	33	1,242	422

<sup>a</sup>3/8-in. basis equivalent.**Table 5—Percentages of wood usage in floor sheathing, coverage of first and upper floor area, by housing type for selected years**

Product	Wood usage (%)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	70.8	61.8	92.7	62.4	72.9	61.8
OSB	11.0	13.7	6.9	22.8	22.9	30.9
Other	5.3	6.6	0.4	14.8	5.2	7.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

**Table 6—Wood usage in floor sheathing, amount of product used, by housing type for selected years**

Product	Wood usage ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	1,421	410	103	31	1,524	441
OSB	517	233	9	12	526	245
Other <sup>a</sup>	110	6	1	1	111	7
Total	2,047	648	113	44	2,161	693

<sup>a</sup>3/8-in. basis equivalent.

Essentially all of the decline was in owner-occupied housing units. Data relating to room additions from the AHS suggest the number of room additions in owner-occupied housing units in 2014 was down roughly 20% from 2006. The remaining difference in the decline in lumber and I-joist use in owner-occupied repair and remodeling was driven by a combination of decreased size of the additions and fewer repair projects. On a board foot equivalent basis, the I-joist share in owner-occupied projects showed little change, falling from 23% in 2006 to 22% in 2014.

The HIRL estimates of floor sheathing coverage provide information on market shares of products used based on square feet of coverage. In contrast to the Annual Builders Survey, estimates of concrete slabs used in repair and remodeling are not made in the CPS. As shown in Table 4, the amount of floor sheathing coverage fell 66% in total. Owner-occupied coverage fell 67% and renter-occupied coverage fell 50%.

In total, there was little change in percentage share of structural panels used in floor sheathing (Table 5). Focusing on owner-occupied housing, plywood's share declined at the expense of oriented strandboard (OSB). In terms of structural panels only, plywood's share fell from 75% in 2006 to 66% in 2014. These share estimates are quite different than those reported for new construction in HIRL's Annual Builder's Practices Survey, in which plywood's share in these years is near 30% and OSB's share is 70%. Some of this difference may be explained by a misidentification in the CPS, where the respondent mistakenly checked plywood. Or, it could reflect a preference to use plywood, if the project was done by the occupant and they were more familiar with that product.

Based on the reported distribution of panel usage by thickness, the estimated 2014 floor sheathing volume in total was 693 million ft<sup>2</sup> on a 3/8-inch basis, down 68% from 2006 (Table 6). The wood structural panel component fell 67%. Given the dominance of owner-occupied housing in the estimates, the percentage declines in this component essentially equals that of the total.

## Wall Applications

The use of wood products in wall framing activities, which includes window and door headers, fell from almost 2.4 billion board feet equivalent in 2006 to 1.06 billion board feet equivalent in 2014, a drop of 55% (Table 7). Wood product use in owner-occupied housing fell 57% and its use in renter-occupied housing fell 27%. Thus, owner-occupied housing's share of wood products usage fell from 94% in 2006 to 90% in 2014.

Based on square footage of exterior wall covered, plywood is reported to be the dominant product used in wall sheathing for both owner- and renter-occupied housing (Table 8).

**Table 7—Wood usage in wall framing**

Product	Wood usage ( $\times 10^6$ board feet or BFE <sup>a</sup> )					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
<b>Wall framing</b>						
Dimension lumber	1,982	654	122	63	2,104	717
Posts and beams	173	216	19	39	192	255
Subtotal	2,155	870	141	102	2,296	972
<b>Window and door headers</b>						
Lumber (built up)	61	60	4	5	65	65
Solid sawn beams	15	15	1	1	16	16
Glulam	5	5	0.3	0.4	5.3	5.4
I-joists	1	1	0.2	0	1.2	1
Laminated veneer lumber	2.6	2.6	0.1	0.2	2.7	2.8
Parallam	1	1	0	0	1	1
Subtotal	85	85	6	6	91	91
Total	2,240	955	147	108	2,387	1,063

<sup>a</sup>BFE, board feet equivalent.**Table 8—Wood usage in wall sheathing, amount of exterior walls covered**

Product	Wood usage ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	619	240	35	23	654	273
OSB	353	115	23	22	386	137
Fiberboard	63	46	16	6	79	52
Foam	64	77	10	14	74	87
Other	109	26	4	5	113	31
Total	1,207	534	88	70	1,295	604

<sup>a</sup>3/8-in. basis equivalent.**Table 10—Wood usage in wall sheathing, amount of product used**

Product	Wood usage ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	826	337	46	30	872	367
OSB	486	190	32	30	518	220
Foam <sup>a</sup>	86	105	13	16	99	121
Other <sup>a</sup>	231	99	25	14	256	113
Total	1,629	731	116	90	1,745	821

<sup>a</sup>3/8-in. basis equivalent.**Table 9—Percentage of wood usage in wall sheathing, amount of exterior walls covered**

Product	Wood usage (%)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	51.3	45.0	40.2	32.8	50.5	43.6
OSB	29.3	27.1	26.5	31.4	29.1	27.6
Fiberboard	5.2	8.7	17.8	9.2	6.0	8.8
Foam	5.3	4.4	11.6	19.7	5.7	15.0
Other	9.0	4.8	4.0	6.9	8.7	5.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

The respective market shares for wood structural panels and other sheathing products for owner- and renter-occupied housing for 2006 and 2014 are shown in Table 9. Perhaps the biggest shift is the reported increase in foam at the expense of wood structural panels in owner-occupied housing and fiberboard in renter-occupied housing. The increase in foam's share cannot be attributed solely to a shift in the regional mix of activity. The reported square footage of wall repair and remodeling activity in owner-occupied housing in the southern United States rose slightly from 36% in 2006 to 38% in 2014. The shift in foam use was reported to be across all regions.

If we focus on just the use of plywood and OSB in exterior wall sheathing in new construction, we see much different

**Table 11—Lumber usage in roof framing**

Product	Lumber usage ( $\times 10^6$ board feet)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Lumber	2,968	1,364	114	74	3,082	1,438

**Table 12—Wood usage in roof sheathing, amount of roof area covered**

Product	Wood usage ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	1,002	386	63	9	1,065	395
OSB	401	232	47	21	448	253
Other <sup>a</sup>	135	38	10	5	145	43
Total	1,538	655	120	35	1,658	690

<sup>a</sup>3/8-in. basis equivalent.**Table 13—Percentage of wood usage in roof sheathing, amount of roof covered**

Product	Wood usage (%)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	65.1	58.9	52.7	25.4	64.2	57.2
OSB	26.1	35.4	39.2	60.34	27.0	36.6
Other	8.8	5.7	8.1	14.2	8.8	6.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

**Table 14—Wood usage in roof sheathing, amount of product used**

Product	Wood usage ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	1,423	730	80	20	1,503	750
OSB	591	426	34	28	625	454
Other <sup>a</sup>	194	56	13	2	206	58
Total	2,208	1,212	127	49	2,334	1,261

<sup>a</sup>3/8-in. basis equivalent.

usage patterns. In the CPS estimates, plywood use averaged a 63% share of wood structural panel use in owner-occupied wall sheathing in 2006 and 2014. In contrast, the plywood share averaged just 15% in new single-family construction in these two years. Given that approximately half of the room additions were done by professionals, according to the AHS, the expected result from HIRL's CPS is that the plywood share should have been considerably less than the reported 63%.

The respective product usage estimates in wall sheathing applications are shown in Table 10. The percentage changes on a 3/8-in. basis are closely aligned with the estimated changes shown in Table 8.

## Roof Applications

Estimates of product usage in roof applications is related to room, garage, and carport additions and replacement of existing roofs. Interpolation was used with the 2013 and 2015 AHS data to generate an estimate for 2014, which showed that the number of roofing repair projects in 2014 was apparently down 9% from 2006. The combined number of room, garage, and carport additions to existing structures fell from 448,000 in 2006 to 368,000 in 2014, a decline of 18% if the AHS data were used as the basis for the calculation.

With respect to roof framing, the CPS estimates show only lumber being used. This is not meaningfully different from new construction, in which lumber accounts for about 96% of the products used, with I-joists and steel accounting for the remaining 4%. The extent of the decline in lumber use between 2006 and 2014, based on the CPS estimates, is 53% in total and 54% for the owner-occupied segment (Table 11). This is much greater than expected, based on the room addition and roofing project data, but seems to fit the pattern in the floor and wall applications.

The total square footage of roof covering driven by additions and roof projects for 2014 was estimated to be 690 million ft<sup>2</sup>, down 58% from 2006 (Table 12). In the same time period, square footage of roof covering in the owner-occupied segment fell 57%.

The estimated shares of roof area covered are shown in Table 13. Similar to floor and wall sheathing data, the plywood share is much greater than that of OSB. This is counterintuitive. Given that 80% of the roofing projects were done by professionals, the expectation is that roofers would behave in a manner similar to building a new home, for which OSB's share of the roof area covered averages 73% versus 26% for plywood and 1% for the remainder.

The associated product use comparisons are shown in Table 14. Roofing projects within the owner-occupied stock

accounted for 95% to 96% of all products used in the survey years of 2006 and 2014.

## Wood Products Used in Cabinets and Countertops

Remodeling of kitchens and bathrooms is a critical end-use market for cabinet manufacturers in the United States. As previously discussed, the number of kitchen and bathroom remodels based on the AHS data peaked in 2007, as did the average expenditure per project, most notably with respect to kitchens. Interpolation was performed on the expenditure data for 2005 and 2007 for kitchen and bathroom remodels and for the same data for 2013 and 2015 to develop reasonable estimates for expenditures in 2006 and 2014, respectively. This yielded declines of 24% for kitchen remodels and 17% for bathroom remodels from 2006 to 2014. In their CPS, HIRL asks how many kitchen and vanity cabinets were purchased. The purchase estimates are shown in Table 15.

Focusing on the owner-occupied estimates from HIRL, from 2006 to 2014, the number of kitchen cabinets purchased was down 28% and the number of vanity cabinets was down

19%. The close tie between estimated remodel projects and cabinet purchases suggests cabinet purchases per dollar spent has been relatively constant or a predictable number during the 8-year period.

HIRL is surveying consumers and not cabinet manufacturers; therefore, they cannot generate estimates of the volumes of products used in the production process. However, HIRL does ask a question pertaining to the material used to make the cabinet. The estimated numbers and the relative distributions for 2006 and 2014 are shown in Tables 16 and 17. As evidenced in Table 17, there appears to have been virtually no change in the respective shares of products used to manufacture cabinet boxes from 2006 to 2014.

HIRL's estimates of the use of plywood and composite wood products in countertops are shown in Table 18. The decline in owner-occupied repair and remodel use exceeds that of cabinet purchase estimates, suggesting the penetration of other materials. However, the plywood share in owner-occupied countertop use was unchanged at 44% between 2006 and 2014.

**Table 15—Number of cabinets purchased by type of room**

Product	Number of cabinets (millions)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Kitchen	30.745	22.179	3.115	2.046	33.860	24.225
Vanity	3.419	2.767	0.310	0.395	3.720	3.162
Total	34.164	24.946	3.416	2.441	37.580	27.367

**Table 16—Number of cabinets purchased by product**

Product	Number of cabinets purchased (millions)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Solid wood	3.595	2.681	0.368	0.264	3.963	2.945
Wood veneer on particleboard or MDF <sup>a</sup>	17.854	13.032	1.782	1.271	19.636	14.303
Plastic, paper overlay, or laminate on particleboard	8.147	5.857	0.801	0.569	8.948	6.426
Plywood	4.519	3.339	0.460	0.333	4.979	3.672
Other	0.049	0.036	0.005	0.004	0.054	0.040
Total	34.164	24.946	3.416	2.441	37.580	27.367

<sup>a</sup>MDF, medium-density fiberboard.

**Table 17—Relative distribution of cabinets by type**

Product	Relative distribution (%)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Solid wood	10.5	10.8	10.8	10.8	10.6	10.8
Wood veneer on particleboard or MDF <sup>a</sup>	52.3	52.2	52.2	52.1	52.3	52.2
Plastic, paper overlay, or laminate on particleboard	23.9	23.5	23.5	23.3	23.8	23.5
Plywood	13.2	13.4	13.5	13.6	13.3	13.4
Other	0.1	0.1	0.1	0.2	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

<sup>a</sup>MDF, medium-density fiberboard.

**Table 18—Wood products usage in countertops**

Product	Wood usage in countertops ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Plywood	51	30	5	5	56	35
Particleboard or MDF	64	38	8	8	72	46
Total	115	68	13	13	128	81

<sup>a</sup>3/8-in. basis.

## Wood Products Used in Siding

Reflecting the diversity of construction methods across the nation, there is a wide variety of siding products used in residential repair and remodeling (Table 19). For the two years in question, owner-occupied housing accounted for almost 90% of the total siding product usage in residential repair and remodeling. In terms of the amount of square footage of exterior wall space covered, total use of siding products in 2014 was down by roughly 30% from 2006. Siding product use in owner-occupied housing projects fell 33%, whereas it was down 22% in renter-occupied housing.

This estimated decline in owner-occupied housing is consistent with the project and expenditure estimates from the Census Bureau's AHS for the two years in question; the number of reported siding projects fell 15%, whereas expenditures in total declined 30%. Correlating the siding usage estimates from HIRL with the number of siding projects undertaken as estimated in the AHS makes sense because just 5% to 10% of the siding materials purchased in repair and remodeling applications is for room additions.

From 2006 to 2014, the relative distribution of the types of siding materials used in repair and remodeling changed

considerably. As shown in Table 20, the share of wood-based siding materials more than doubled from 2006 to 2014. Vinyl siding products experienced the largest share loss, falling from roughly 54% in 2006 to 34% in 2014, and fiber cement's share declined from 10% in 2006 to 5% in 2014.

Table 21 shows usage estimates of wood-based siding material in their commonly expressed units. Our primary concern with these estimates from HIRL pertains to plywood and OSB.

- First, the large differential between the estimates for plywood and OSB suggests that, for whatever reason, those filling out the survey are misidentifying some OSB as plywood. This is despite HIRL's best efforts to provide survey respondents pictures and descriptions depicting the differences between the two products.
- Second, if product usage estimates are compared with APA—The Engineered Wood Association production estimates of plywood and OSB siding products, the estimate of 1.014 billion ft<sup>2</sup> of plywood used greatly exceeds the reported production level of 545 million ft<sup>2</sup> in 2014, and we know that there had to be some plywood



**Table 19—Usage of siding materials by type**

Product	Amount of siding materials used ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Wood based	805	1,144	69	225	874	1,369
Lumber	391	619	39	30	930	657
Plywood	215	331	28	157	243	488
OSB	45	28	0	0	45	28
Hardboard	42	88	0	2	42	90
Cedar shakes or shingles	98	78	2	28	100	106
Other wood	14	0	0	0	14	0
Brick	124	178	9	22	133	200
Stone	66	185	0	14	66	199
Stucco	555	228	75	53	630	281
Concrete block	0	20	0	0	0	20
Vinyl	3,008	1,276	357	182	3,365	1,148
Fiber cement	570	217	55	1	625	218
Aluminum or steel	266	367	75	12	341	379
Other <sup>a</sup>	162	118	24	9	186	127
Total	5,556	3,733	664	518	6,220	4,251

<sup>a</sup>3/8-in. basis equivalent.**Table 20—Percentage of siding materials used, amount of exterior wall covered**

Product	Siding material used (%)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Wood based	14.5	30.7	10.4	43.4	14.1	32.2
Lumber	7.0	16.6	5.9	7.3	6.9	15.5
Plywood	3.9	8.9	4.2	30.3	3.9	11.5
OSB	0.8	0.8	0.0	0.0	0.7	0.7
Hardboard	0.8	2.4	0.0	0.4	0.7	2.1
Cedar shakes or shingles	1.8	2.1	0.3	5.4	1.6	2.5
Other wood	0.3	0.0	0.0	0.0	0.2	0.0
Brick	2.2	4.8	1.4	4.2	2.1	4.7
Stone	1.2	5.0	0.0	2.7	1.1	4.7
Stucco	10.0	6.1	11.3	10.2	10.1	6.6
Concrete block	0	0.5	0.0	0.0	0.0	0.5
Vinyl	54.1	34.2	53.8	35.1	54.1	34.3
Fiber cement	10.3	5.8	8.3	0.2	10.1	5.1
Aluminum or steel	4.8	9.8	11.3	2.3	5.5	8.9
Other <sup>a</sup>	2.9	3.2	3.6	1.7	3.0	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

<sup>a</sup>3/8-in. basis equivalent.

**Table 21—Wood usage in siding, amount of product used**

Product	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
Lumber ( $\times 10^6$ board feet)	563	891	57	54	620	946
Cedar shakes or shingles ( $\times 10^6$ board feet)	122	97	2	35	124	133
Plywood ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>	448	688	58	326	506	1,014
OSB ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>	81	51	12	0	93	51
Hardboard ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>	61	130	0	2	63	132

<sup>a</sup>3/8-in. basis.**Table 22—Reconciliation of structural panel siding production and consumption in the United States, 2014**

Product and consumption category	Production and consumption ( $\times 10^6$ ft <sup>2</sup> ) <sup>a</sup>
<b>Production</b>	
OSB	695
Plywood	545
Total	1,240
<b>Consumption</b>	
New residential construction	292
Repair and remodeling <sup>b</sup>	877
Total	1,169

<sup>a</sup>3/8-in. basis.<sup>b</sup>Adjusted for likely overestimation of plywood usage in rental housing.

siding used in new construction. Part of the problem is the reported surge in plywood use in rental housing from 58 million ft<sup>2</sup> in 2006 to 326 million ft<sup>2</sup> in 2014. This seems unrealistic for a number of reasons. For example, the number of single-family detached units in the rental stock is one-fifth of that in the owner-occupied stock. Assuming there was the same tendency to have purchased plywood siding per owner-occupied unit, this would lower the 2014 estimate from 326 million to 138 million ft<sup>2</sup>, which still seems extraordinarily high and probably an overestimation.

- Third, comparing the estimated use of plywood with that of OSB in residential repair and remodeling versus comparing the same in new construction yields two differing perspectives. As already shown in Table 21, plywood use in repair and remodeling accounted for 93% of the structural panel use for siding projects in 2014. Contrast that to HIRL's survey of home builders showing that plywood accounted for just 27% of the structural panels used in siding new single-family construction in 2014. With these numbers in mind, let's refer back to

Table 1, in which it is reported that in the AHS, 69% of the siding projects undertaken were done by professionals. It is probably safe to assume that the tendency of professionals to use plywood and OSB in siding projects would be similar to that of home builders. This evidence appears to indicate that plywood use in the HIRL's CPS is greatly overstated and OSB use understated.

With these concerns in mind, we have tried to determine if the combined estimate for structural panel use in residential repair and remodel is, at least, plausible. Production of plywood and OSB identified as siding products totaled 1.24 billion ft<sup>2</sup> in 2014 (Table 22). The estimated consumption level is separated into two parts, new residential and repair and remodeling. The estimated use in new residential consumption is 292 million ft<sup>2</sup>, based on HIRL's builder survey including multifamily construction. Adjusting the estimate for plywood use in renter-occupied residential repair and remodel, as previously discussed, yields an estimate of 877 million ft<sup>2</sup> for repair and remodel in total. The sum of the components (new residential construction plus residential repair and

remodeling) equals 1.17 billion ft<sup>2</sup>. There is some use of siding products in nonresidential construction; how much is unknown. Therefore, making the adjustment to the rental estimate and acknowledging that there is misreporting of the components, it is probably safe to say that we have a plausible estimate for structural panel use in repair and remodel in total for 2014. Regarding the adjusted split between plywood and OSB, the remainder of production, less the estimate for new construction, is 459 million ft<sup>2</sup> for plywood and 489 million ft<sup>2</sup> for OSB. Thus, it might be fair to say that the 877 million ft<sup>2</sup> allocated to residential repair and remodel is a 50–50 split, plus or minus several million square feet.

## Wood Products Used in Outdoor Structures

The last major category of projects to be covered is that of outdoor structures, such as decks and porches. Lumber dominates the wood products used in either adding or renovating a deck or porch. Averaging the number of deck and porch projects undertaken in owner-occupied housing in 2005 and 2007 to develop an estimate for 2006 and doing the same for 2013 and 2015 to develop an estimate for 2014, we see that the number of projects undertaken fell by roughly 30%. Average expenditures per project rose 6%;

therefore, total expenditures fell about 25%, which provides a benchmark for setting the expectations for change in wood products usage.

The estimated use of lumber in decks and porches is shown in Tables 23 and 24, respectively. Composite and nonwood products are included in these estimates. Lumber use in deck projects in owner-occupied housing units is estimated to have increased 10% in 2014 compared with 2006, which contradicts the trend based on the project and expenditure data. Strictly wood-based lumber use is estimated to have increased 11.5%, with treated lumber use up 9% and untreated use rising 49%. Directionally, the estimated use of lumber in porch construction is consistent with the project and expenditure data. However, the estimated decline is just 4%.

In contrast to reconciling the apparent inconsistency with the responses to structural panel use in siding projects, we do not have a readily apparent means for reconciling the difference here. Perhaps our best answer is to say there is considerable difference with respect to the experience base of the different samples. But it is still useful to include these data because they provide some valuable insight in terms of the use of wood-based lumber relative to plastic composites in deck and porch construction.

**Table 23—Lumber used in decks**

Product	Amount of lumber used ( $\times 10^6$ board feet)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
<b>Framing</b>						
Treated	4,567	4,967	266	413	4,833	5,380
Untreated	181	270	12	46	193	316
Subtotal	4,748	5,237	278	459	5,026	5,696
<b>Surfaces</b>						
Treated	617	700	43	31	202	188
Untreated	181	270	12	46	193	316
Wood–plastic composites	199	188	3	0	202	188
PVC, vinyl, fiberglass	98	34	3	25	101	59
Subtotal	1,095	1,192	61	102	1,156	1,294
Total	5,843	6,429	339	561	6,147	6,990
Treated	5,184	5,667	309	444	5,593	6,111
Untreated	362	540	24	92	386	632
Total	5,546	6,207	333	536	5,979	6,743

**Table 24—Lumber used in porches**

Product	Amount of lumber used ( $\times 10^6$ board feet)					
	Owner-occupied		Renter-occupied		Total	
	2006	2014	2006	2014	2006	2014
<b>Framing</b>						
Treated	110	95	11	4	121	99
Untreated	945	889	66	92	1,011	981
Subtotal	1,055	984	77	96	1,132	1,080
<b>Surfaces</b>						
Treated	110	95	11	4	121	99
Untreated	105	98	6	17	111	115
Wood–plastic composites	91	78	3	2	94	80
PVC, vinyl, fiberglass	142	187	4	9	146	196
Subtotal	448	458	24	32	472	490
Total	1,503	1,442	101	128	1,664	1,570
Treated	220	190	22	8	242	198
Untreated	1,050	987	72	109	1,122	1,096
Total	1,270	1,177	94	117	1,364	1,294

## Implications for Future Residential Repair and Remodeling Activity

The project and expenditure estimates from the AHS help to illustrate the strength of repair and remodeling activity in association with the housing bubble of the first half of the 2000 to 2010 decade. The decline in equity among homeowners driven by lower home prices, the sustained descent in the homeownership rate, and a host of economic challenges have worked to frustrate the recovery in repair and remodeling activity through the first half of the 2010 to 2020 decade.

Some analysts argue the stage has been set for much stronger growth in repair and remodeling activity through the rest of the 2010 to 2020 decade. One of the arguments in favor of this is the aging of the housing stock. As shown in Figure 36, the median age of the stock of single-family detached units was almost 40 years old, which is up from 32 years old in 2007. But it is also the case that through maintenance and repair spending and because the quality and attributes of homes built have improved, we continue to extend the life of the existing stock. This is not only true for single-family detached units, but it is also true for other types of structures that make up the existing stock.

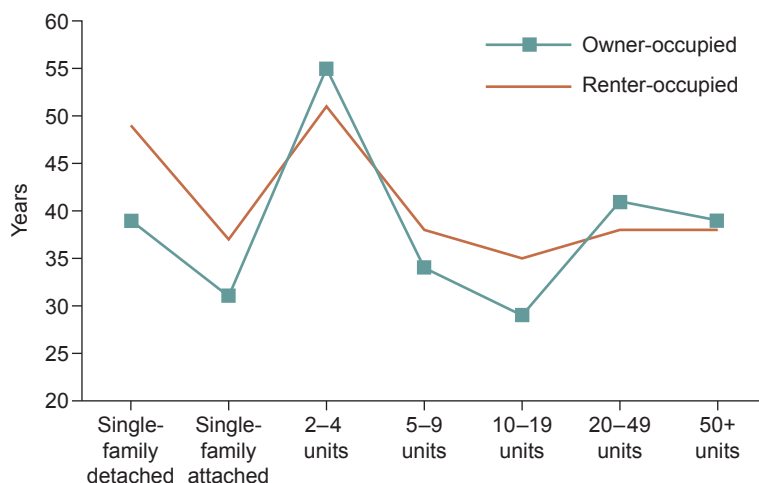
Growth in the housing stock will track that of households, which is expected to be about 1.2% per year. Therefore, as the housing stock increases in size, repair and remodeling

should grow at a minimum of that amount. The question, then, is how much more growth is driven by rising incomes? If income growth per household is averaging 2% per year, we may be able to count on repair and remodeling growing in total at a rate of at least 3% per year, or more.

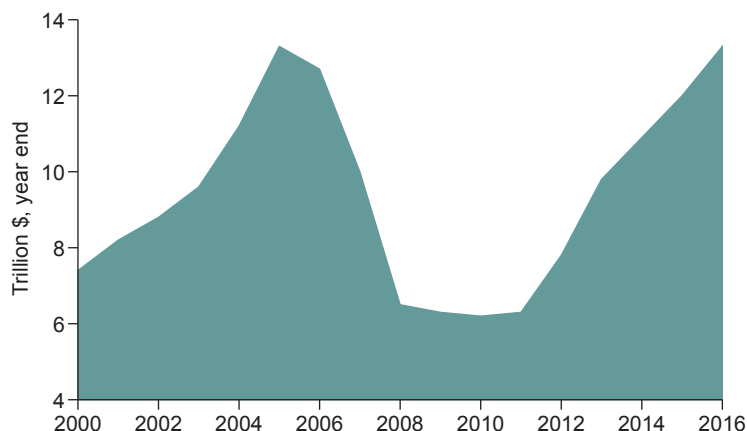
Homeowner equity in 2016 returned to where it was at the 2005 peak of the housing bubble in nominal dollar terms. As shown in Figure 37, homeowners are not extracting cash via refinance at a rate anywhere close to that of 2005 to 2007. With mortgage rates likely to move higher, the incentive to refinance to extract cash will diminish. Thus, we should not expect much of a boost, if any, in growth in repair and remodeling driven by higher cash-outs, as appreciating home prices add to consumer wealth.

As previously discussed, savings was cited as the financing source of almost 75% of the expenditures on the wood-intensive projects in the 2013 to 2015 time frame. Although consumer confidence is back to where it was prior to the onset of the Great Recession, it is not clear that homeowners are willing to increase the rate at which they tap existing savings to spend on the more discretionary types of repair and remodeling projects.

Finally, more demands have been put on builders, which has added costs to the permitting process for new construction. The same is true for major projects, such as a room addition. This will tend to constrain the number of room additions.



**Figure 36. Median age of occupied U.S. housing stock in 2015 by type of structure and tenure (USDC 2017).**



**Figure 37. Owner's equity in residential real estate for selected years at year-end (FRB 2018a).**

The bottom line is that we should not count on sustained growth in repair and remodeling activity that exceeds 3% per year, especially with respect to those types of projects that are discretionary and tend to be more wood-products intensive.

## Literature Cited

- Adair, C.; McKeever, D.B. 2009. 2006 wood used in residential repair & remodeling U.S. and Canada, with comparison to 1997 and 2003. Tacoma, WA: APA—The Engineered Wood Association. 120 p. [http://www.fpl.fs.fed.us/documnts/pdf2009/fpl\\_2009\\_adair001.pdf](http://www.fpl.fs.fed.us/documnts/pdf2009/fpl_2009_adair001.pdf).
- FRB. 2018a. Financial accounts of the United States - Z.1: B.101 balance sheet of households and nonprofit organizations. Washington, DC: Board of Governors of the Federal Reserve System. <https://www.federalreserve.gov/releases/z1/current/html/b101.htm>.
- FRB. 2018b. Financial accounts of the United States - Z.1: L.218 home mortgages. Washington, DC: Board of Governors of the Federal Reserve System. <https://www.federalreserve.gov/releases/z1/current/html/l218.htm>.
- Freddie Mac. 2018. Quarterly refinance statistics. McLean, VA: Freddie Mac. <http://www.freddiemac.com/research/datasets/refinance-stats/index.html>.
- JCHS Harvard University. 2017. Improving America's housing 2017 demographic change and the remodeling outlook. Cambridge, MA: Joint Center for Housing Studies of Harvard University. 40 p.
- McKeever, D.B.; Howard, J.L. 2011. Solid wood timber products consumption in major end uses in the United States, 1950–2009: a technical document supporting the Forest Service 2010 RPA assessment. Gen. Tech. Rep. FPL-GTR-199. Madison, Wisconsin: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 41 p. [https://www.fpl.fs.fed.us/documnts/fplgtr/fpl\\_gtr199.pdf](https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr199.pdf).

USDC. 2017. American Housing Survey, 2015. Washington, DC: U.S. Department of Commerce, Bureau of the Census. <https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html>.

USDC. 2018a. Historical households tables. Washington, DC: U.S. Department of Commerce, Bureau of the Census. <https://www.census.gov/data/tables/time-series/demo/families/households.html>.

USDC. 2018b. Housing vacancies and homeownership (CPS/HVS). Washington, DC: U.S. Department of Commerce, Bureau of the Census. <https://www.census.gov/housing/hvs/index.html>.

USDC. 2018c. Monthly & annual retail trade. Washington, DC: U.S. Department of Commerce, Bureau of the Census. <https://www.census.gov/retail/index.html>.



## **Appendix A—Housing Unit Definitions**

### **Multifamily Housing**

Residential buildings containing units built one on top of another and those built side-by-side that do not have a ground-to-roof wall and/or do have common facilities (attic, basement, heating plant, plumbing, etc.)

### **Single-Family House**

The single-family statistics include fully detached, semidetached (semi-attached, side-by-side), row houses, and townhouses. In the case of attached units, each must be separated from the adjacent unit by a ground-to-roof wall to be classified as a single-family structure. Also, these units must not share heating or air-conditioning systems or utilities.

Units built one on top of another and those built side-by-side that do not have a ground-to-roof wall and/or do have common facilities (attic, basement, heating plant, plumbing, etc.) are not included in the single-family statistics.





